Space Weather Technical Forecast

Issued on Thursday, 23 June 2022 at 01:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Daily Chance of an isolated M-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares. There are currently four sunspot regions on the visible disc. The largest and most complex remains AR3038 (Eki/Beta-Gamma) in the northwestern quadrant, which has remained stable. AR3035 (Cro/Beta) has retained rudimentary penumbra around the leader portion of the spot, but appears to have lost some intermediate spots. AR3040 in the southeast quadrant remains classified as a Cso/Beta configuration.

No Earth directed CMEs (Coronal Mass Ejections) are currently expected, although a filament eruption occurred around 22/1900 UTC from the northwest quadrant. However, further imagery is required before an analysis can take place.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, fluctuated between roughly 410-540 km/s throughout the past 24 hours. The density was at average to above average levels, peaking at 21 ppcc at 22/2219 UTC. The IMF was generally weak 5-8 nT, but briefly peaked at moderate levels of 9 nT at 22/1256 UTC. The Bz varying between +5 and -7nT. The phi angle remained negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3) intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured by GOES16 remained at background levels through the period. Electron flux (greater than 2MeV) was generally at Moderate to High levels in the period, with a peak of 1178 pfu observed at GOES16 at 22/1550 UTC. The corresponding 24-hour integrated electron fluence has been on a declining trend, remaining below the Active threshold (>1e8 integrated pfu). Observed fluence was 4.87e7 integrated pfu at 22/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a daily chance of an isolated M-class flare and very slight chance of an X-flare.

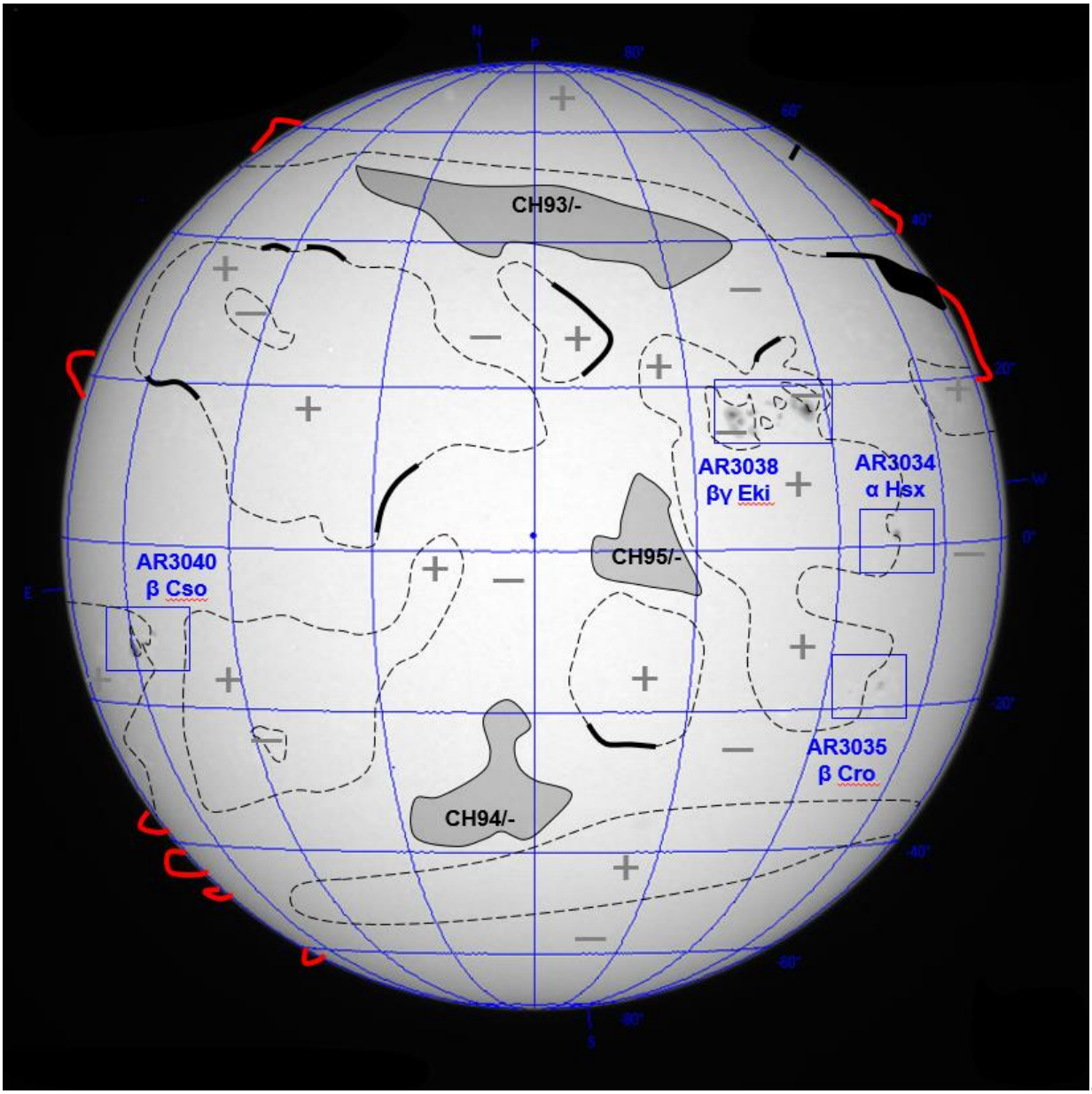
Solar Wind / Geomagnetic Activity: No CMEs currently feature in the forecast, although at least one potential CME from a filament eruption will be analysed once imagery becomes available.
Solar winds are expected to remain slightly elevated to elevated, under the influence of coronal hole high speed streams from CH93 and CH95. Geomagnetic activity is expected to be Quiet (Kp 1-2) initially, and again day 4 (26th) but with possibly isolated Unsettled (Kp 3) intervals, then becoming Unsettled to Active (Kp 3-4) with a slight chance of a G1/Minor storm (Kp 5) during Days 2 and 3 (24th/25th).

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event. The high energy electron flux (greater than 2 MeV) is expected to be at Background to Moderate levels today and tomorrow, with a chance of briefly reaching High levels at the peak of the diurnal cycle. During days 3 and 4 (25th and 26th) the high energy electron flux is likely to increase to moderate to high levels, under the influence of the HSS from CH93 and CH95. The associated 24-hour integrated fluence is expected to continue on a downward trend below the Active threshold today and tomorrow, then start increasing during days 3 and 4, with an increasing chance of reaching the Active threshold by late day 4.

Figure 1. Solar Analysis Valid 22/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

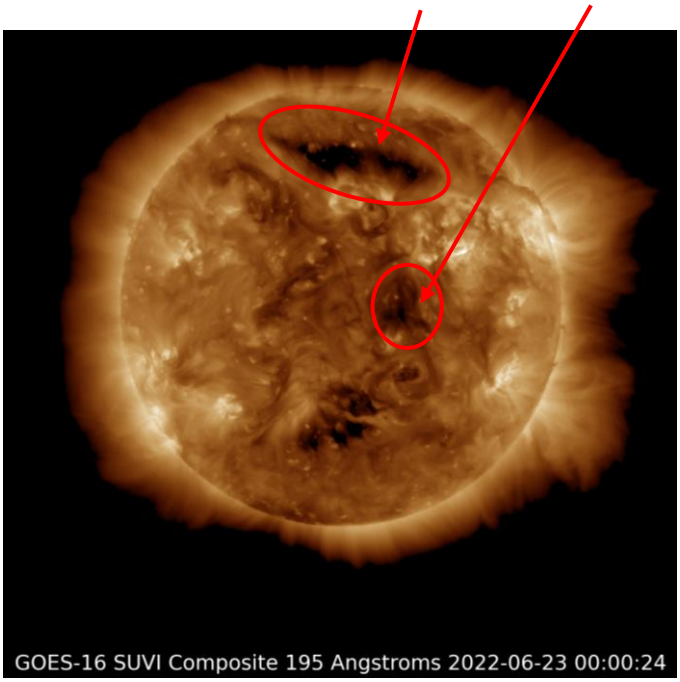
Geomagnetic Storms:

No CMEs currently feature in the forecast, although at least one potential CME from a filament eruption will be analysed once imagery becomes available.

The Earth has been encountering slightly elevated to elevated wind speeds, and through the forecast period little is expected to change. This is due to the influence of a HSS from CH93/- tomorrow (24th), quickly followed by another HSS from CH94/-, which is most likely to arrive on day 3 (25th).
Geomagnetic activity is expected to be Quiet (Kp 1-2) initially, and again day 4 (26th) but with possibly isolated Unsettled (Kp 3) intervals, then becoming Unsettled to Active (Kp 3-4) with a slight chance of a G1/Minor storm (Kp 5) during Days 2 and 3 (24th/25th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Latest GOES-16 195 image showing CH93 and CH95.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are currently four sunspot regions on the visible disc. The largest and most complex remains AR3038 (Eki/Beta-Gamma) in the northwestern quadrant, which has remained stable. AR3035 (Cro/Beta) has retained rudimentary penumbra around the leader portion of the spot, but appears to have lost some intermediate spots. AR3040 in the southeast quadrant remains classified as a Cso/Beta configuration.

There are several moderately large filaments present on the disk, and will be monitored for any potential lift-off. Some bright flux regions are also visible on STEREO A EUVI 195 imagery, close to the eastern limb, suggesting the presence of sunspot regions. These could potentially emerge from the far side over the next couple of days, leading to a readjustment of the probabilities.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels and is expected to remain at this level through the period. However, there is a slight chance of an S1 or greater event through the next four days as AR3038 rotates across the western disc. This region is relatively large, complex with some further development. As such, it carries a slightly elevated risk of solar radiation storm.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

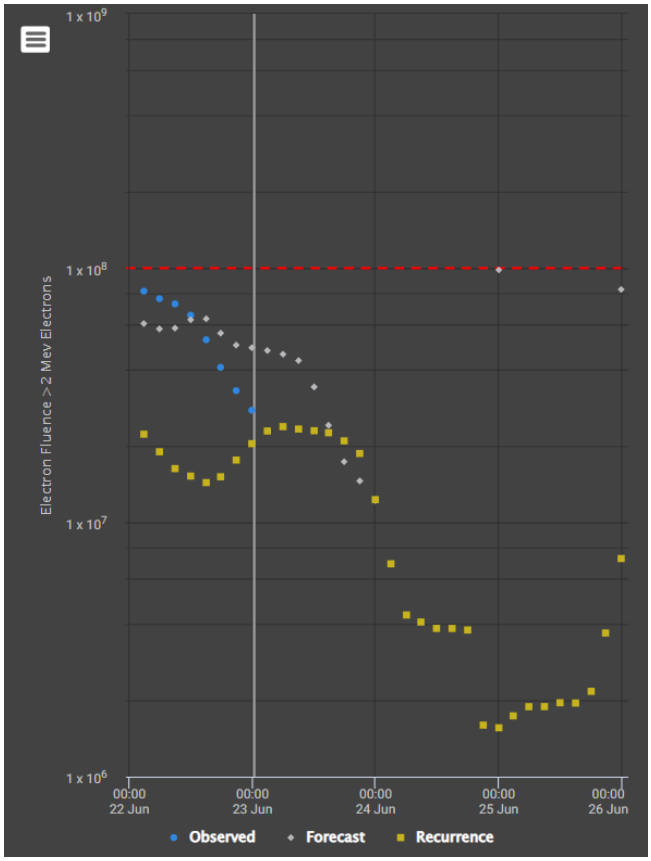
© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) is expected to be at Background to Moderate levels today and tomorrow, with a chance of briefly reaching High levels at the peak of the diurnal cycle. During days 3 and 4 (25th and 26th) the high energy electron flux is likely to increase to moderate to high levels, under the influence of the HSS from CH93 and CH95. The associated 24-hour integrated fluence is expected to continue on a downward trend below the Active threshold today and tomorrow, then start increasing during days 3 and 4, with an increasing chance of reaching the Active threshold by the end of the forecast period. With this in mind the Met Office REFM model is considered to be giving reasonable guidance, although the rate of increase for the fluence for day 2 (24th) is considered excessive.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	20	30	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Met Office REFM model.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.